

## Primary Re-Ignition Case Study

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*DLN-1 high load transfer; very specific solutions can eliminate upsets and control costs.*

### SITUATION

DLN-1 combustion systems must operate in the Premixed Steady-State (PMSS) combustion mode to achieve low NO<sub>x</sub> and CO emissions. DLN-1 combustion systems transfer from the Lean-Lean (LL) combustion mode to PMSS mode as the gas turbine load increases above nominally 50% load. The combustion system remains in PMSS mode between 50% and base load.

Momentary system upsets such as gas supply pressure fluctuations, the presence of liquids in the fuel, gas control valve fluctuations, or instrumentation problems can cause the flame to re-ignite in the primary combustion zone. This primary re-ignition (PRI) causes the unintended transfer of the combustor from PMSS to Extended Lean-Lean (LL-EXT) mode. In LL-EXT mode, the gas turbine operates out of emissions compliance, with NO<sub>x</sub> increasing from single digits to approximately 100 ppm. Additionally, operation in LL-EXT mode results in a life maintenance factor of 10 for the combustor hardware.

One of the nation's largest producers and transporters of energy, with a portfolio of approximately 26,000 megawatts of generation, 14,400 miles of natural gas transmission, gathering and storage pipeline, and 6,500 miles of electric transmission lines was experiencing upsets on two of their natural gas turbines units. A significant amount of valuable uptime was being lost plus the parts life cycle was threatened. The OEM wanted to provide a comprehensive list of upgrades. The operator reached out to Turbine Technology Services (TTS) to provide a solution that addressed the specific problem.

### CHALLENGE

Historically, recovering from an unintended transfer to LL-EXT mode has required the following steps:

1. Detection of the PRI by the operator, either through observation of the alarm on the HMI or, if HMI alarm is undetected, by a high emissions alarm on the continuous emissions monitoring system (CEMS)
2. Manual unloading of the gas turbine by the operator until Lean-Lean Positive Mode is achieved, typically about 30% load
3. Re-loading of the gas turbine back to the original load set point. Normal transfer into PMSS mode will occur at approximately 50% load.

The recovery process from a PRI typically takes in the range of 10-20 minutes. In some instances, the gas turbine may be required to shut down and then restart to avoid a violation of the regulatory emissions permit.

### SOLUTION

TTS' solution included installing a new logic in the gas turbine's MK V controller to perform a High-Load, Automatic Transfer (HLAT) back to premix mode after a PRI. The new logic:

- Automates and speeds up the recovery process from a PRI.
- Eliminates the need to unload and reload the gas turbine for the transfer back into PMSS mode to occur.

- Minimizes the amount of time that the unit operates out of emissions compliance.
- Upon detection of LL-EXT mode, the new logic will automatically initiate a transfer back to PMSS mode.

Upon detection of LL-EXT mode, the new HLAT logic will automatically initiate a transfer back to PMSS mode at whatever load the unit is currently operating at. The transfer to PMSS mode occurs within approximately 1-2 minutes. The new logic will limit how frequently the transfer can be attempted within a given period in the event the PRI is not caused by a single, momentary upset but is instead being induced by some recurring system or hardware problem.

#### EXECUTION

- Implementation of the new logic on-site included testing with the unit online to confirm that the new logic operates correctly.
- TTS modified the HMI to add an enable/disable button for the high load automatic transfer and to enable a manual initiation of a high load transfer.
- TTS provided a report that details the control logic modifications and included trend plots demonstrating the successful operation of the high load automatic transfer.
- The project required two twelve (12) hour days on-site for the implementation of the logic and HMI changes and testing on each unit.

“TTS’ engineering team came into our facility and completed the project just as they said they would. Two days for each unit and the new logic is working flawlessly. We couldn’t be more pleased.”  
Maintenance Supervisor.

